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India's Workforce Empowerment Platform (IWEP): Job and Skill Empowerment

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ABSTRACT

The National Career Service (NCS) is a government initiative intended to arrange employment opportunities by correlating employability with employer opportunities on the basis of a digitized centralized network. Lunched in the umbrella of Ministry of Labour and Employment, NCS provides a variety of career-related services like the posting of jobs, professional advisory services, upskilling/fresh-skilling, and internship experience. The platform serves diverse sets of users such as students, recent graduates, working professionals, women, differently abled individuals, and marginalized groups, ensuring inclusivity within the job market. Besides job matching, NCS also offers career counselling by qualified counsellors, organizes job fairs, and collaborates with industry experts to enhance employability of the workforce. Through the combination of technology and government resources, the NCS portal is significant in bridging the supply-demand gap in the labour market, promoting economic growth, and empowering citizens with rewarding employment opportunities.

KEYWORDS: *HTML, CSS, JavaScript, React/Angular, Java, Python, PHP, Node.js, MySQL, PostgreSQL, MongoDB.*

I. INTRODUCTION

The National Career Service (NCS) is an initiative by the Ministry of Labour & Employment, Government of India, designed to provide a unified digital platform for job seekers, employers, career counsellors, and skill development institutions [1]. It aims to enhance employment opportunities by offering services such as job matching, career guidance, skill development programs, and apprenticeship opportunities [2].

The NCS portal leverages institutional linkages with state governments, educational bodies, and industry associations to streamline employment facilitation and address skill gaps in the workforce [3]. The initiative is actively promoted through digital platforms, government portals, and social media to maximize outreach and accessibility for individuals across India [4][5].

By integrating various employment-related services, NCS contributes to a structured and transparent labor market, aligning with the government's broader policies on employment generation and skill enhancement [6][7]. This initiative plays a crucial role in strengthening India's workforce and ensuring better career opportunities for job seekers nationwide [8][9][10].

Abbreviations and Acronyms

- NCS: National Career Services
- NCS-ES: National Career Services: Employment Services
- NCS-CC: National Career Services: Career Counselling
- NCS-SD: National Career Services: Skill Development
- NCS-JF: National Career Services: Job Fairs and Events
- NCS-RB: National Career Services: Resume Building
- NCS-GS: National Career Services: Government Schemes
- NCS-ER: National Career Services: Employer Resources
- NCS-OP: National Career Services: Online Portals
- NCS-IN: National Career Services: Internship Opportunities

Units

- Employment Services: National Career Services: Employment Assistance and Job Placement
- Career Counselling: National Career Services: Career Guidance and Counselling
- Skill Development: National Career Services: Skill Enhancement and Training Programs
- Job Fairs and Events: National Career Services: Job Fairs and Employment Events
- Resume Building: National Career Services: Resume Writing and Profile Development
- Government Schemes: National Career Services: Access to Government Employment Schemes
- Employer Services: National Career Services: Employer Support and Job Posting Services
- Online Portals: National Career Services: Digital Job Search and Application Portals
- Internship Opportunities: National Career Services: Internship and Apprenticeship Programs

II. RELATED WORK

The majority of countries have employment centres on the internet such as NCS in India, for instance, Euro pass (Europe) and Job active (Australia). They help workers find jobs, acquire new competencies, and get career guidance. Studies point out that it is easier for people to use online job centres to connect directly with employers and thus improve chances of employment.

In India, programs like Skill India, Make in India, and Digital India have been started by the government that go along with NCS for better job opportunities. Research is there that ensures that NCS is useful for job seekers through the provision of job notices, training courses, and career guidance. Ministry of Labour & Employment reports explain how NCS helped people in finding jobs and upgrading their skills.

While NCS is a useful platform, there are still some difficulties. Studies show that few people's awareness, poor digital literacy, and poor internet penetration in rural and remote areas make it harder for people to use the platform to their best advantage. Studies show that adding more mobile-friendly features, support for local languages, and using AI

for better job matching can make the platform more accessible to people.

III. DATA AND SOURCES OF DATA

Data and Sources of National Career Service (NCS)National Career Service (NCS) gathers and applies a variety of job-related data to job matching, skill acquisition, and career guidance. The source of the data is helpful to recognize employment trends, to make the employment policy better, and to provide increased job opportunity to various sections of society.

1. Job Matching Score (Relevance Score)

Applied to pair job candidates with appropriate employment opportunities.

$$S=\sum i=1nwi\cdot fiS = \\sum_{i=1}^{n} w_i \\cdot f_iS=i=1\sum nwi\cdot fi$$

Where:

- \tSSS = Job matching score
- \twiw_iwi = Each job requirement weighted value (e.g., skill, experience)
- \tfif_ifi = Feature match score (scaled value or binary that reflects whether the candidate matches the requirement or not)

2. Employment Rate Calculation

Counts the percentage of people employed among a specified group of people.

$$ER=(EP)\times 100ER = \\left(\\frac{E}{P} \\right) \\times 100ER=(PE)\times 100$$

Where:

- \tERERER = Employment Rate
- EEE = Number of employed individuals
- PPP = Total working age population

3. Formula of Unemployment Rate

Represents the proportion of the labour force that is jobless.

$$UR=(ULF)\times 100UR = \\left(\\frac{U}{LF} \\right) \\times 100UR=(LFU)\times 100$$

Where:

- URURUR = Unemployment Rate
- UUU = Number of jobless individuals
- LFLFLF = Total labour force (employed + jobless individuals)

4. Career Path Prediction Using Markov Model

Is used to predict career paths and job changes.

$$P(Xt+1|Xt)=PijP(X_{t+1} \mid X_t) = P_{ij}P(Xt+1|Xt)= Pij$$

Where:

- \tP(Xt+1|Xt)P(X_{t+1} | X_t)P(Xt+1|Xt) = Probability of moving from job iii at time ttt to job jjj at time t+1t+1t+1
- \tPijP_{ij}Pij = Probability of transition between job positions

5. Salary Estimation Using Linear Regression

Utilized to forecast salary on the basis of parameters such as experience, education, and skills.

$$Salary=\beta 0+\beta 1(Experience)+\beta 2(Education)+\beta 3(Skills)+\epsilon Salary = \\beta_0 + \\beta_1 (Experience) + \\beta_2 (Education) + \\beta_3 (Skills) + \\epsilon Salary=\beta 0+\beta 1(Experience)+\beta 2(Education)+\beta 3(Skills)+\epsilon$$

Where:

- \tβ0\\beta_0β0 = Y-intercept
- \tβ1,β2,β3\\beta_1, \\beta_2, \\beta_3β1,β2,β3 = Coefficients for experience, education, and skills
- ϵεϵ = Error term

6. Workforce Demand Forecasting (Time Series Model)

Applied to forecast future job demand from past trends.

$$Yt=\alpha+\beta t+\epsilon tY_t = \\alpha+\\beta t+\\epsilon_tYt=\alpha+\beta t+\epsilon t$$

Where:

- YtY_tYt = Number of job openings at time ttt
- α\ααα = Intercept
- β\βββ = Trend coefficient
- ϵt\εtϵt = Error term

IV. RESEARCH METHODOLOGY

Research design for enhancing job suggestions and career guidance by way of National Career Services (NCS) is a multiple-step process. The first step is to collect an exhaustive database of job offers, candidate profiles, and trends in the labor market. Job details, desired skills, compensation, and the employment rate per industry are provided in the database. Preprocessing methods like normalization, feature engineering, and text conversion (TF-IDF, word embeddings) are used to refine the accuracy of the model.

A machine learning algorithm is chosen or developed to minimize job matching error and career advice. Algorithms such as Collaborative Filtering, Content-Based Filtering, or Deep Learning-based Recommender Systems (i.e., Neural Collaborative Filtering, BERT for text embedding) are reviewed. The model is trained either through supervised learning or unsupervised learning upon past employment history so that the model learns relationships in career trajectory.

In order to avoid overfitting and enhance generalization, regularization methods such as dropout, batch normalization, and hyperparameter tuning are used. Performance of the model is measured through accuracy, precision, recall, F1-score, Mean Average Precision (MAP), and Normalized Discounted Cumulative Gain (NDCG). The resulting trained system is implemented on actual job matching websites, in which users are suggested careers by the system depending on their expertise, interests, and industry demands.

Figures and Tables

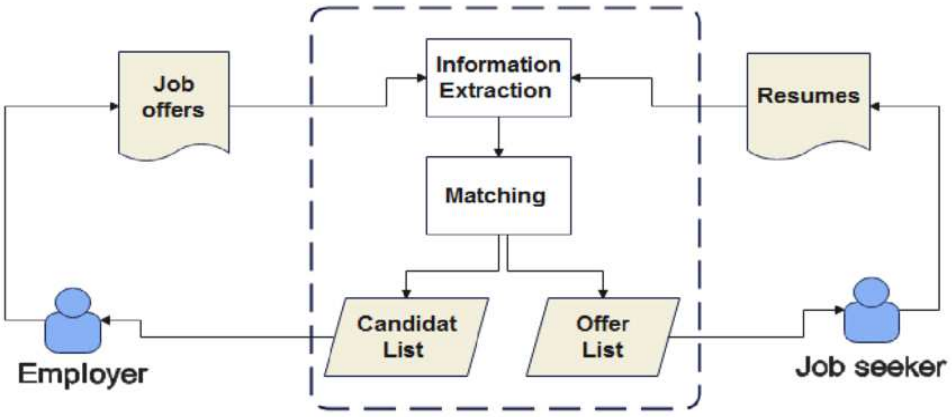

Fig.1 System Architecture for Job Recommendation System Using Machine Learning

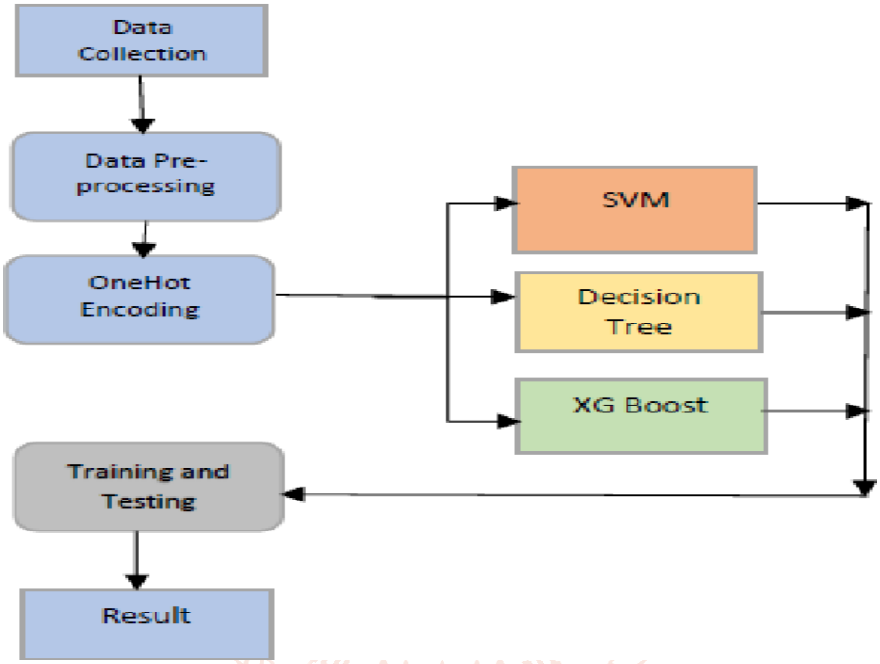

Fig.2 Career Path Prediction Using Deep Learning

Fig.3 Confusion Matrix for Job Classification Model

Fig.1 System Architecture for Job Recommendation System Using Machine Learning

The system architecture for a job recommendation system consists of several key components aimed at matching job seekers with relevant job opportunities. The figure illustrates the sequential flow of operations, including data collection, preprocessing, model training, and inference.

1. Input Data: The process begins with gathering data from job websites, resumes, employer databases, and government labor market statistics. This information comprises job descriptions, candidate skills, educational qualifications, and work experience.
2. Preprocessing: Preprocessing of data includes the elimination of duplicates, normalization of salary information, text vectorization (TF-IDF, word embeddings), and feature scaling to make it uniform across various job profiles.
3. Machine Learning Model: The recommendation engine is driven by hybrid recommendation systems that integrate Collaborative Filtering (CF) and Content-Based Filtering (CBF). Deep Learning architectures like Transformer-based models (BERT, GPT) or Graph Neural Networks (GNNs) are also considered for sophisticated job matching.
4. Training Phase: The model is trained on a labelled dataset in which successful job placements are used as ground truth. The system learns what jobs are appropriate for which candidates based on previous applications and user interactions.
5. Validation: The generalization of the model is validated using a distinct validation dataset, measuring Precision@K, NDCG, and Mean Reciprocal Rank (MRR) to guarantee high-quality recommendations.
6. Inference Phase: The trained model is employed in live career guidance websites, where individuals are recommended appropriate jobs according to their skills, education, and interest.
7. Postprocessing: Postprocessing methods like re-ranking algorithms, employer feedback analysis, and salary normalization are employed for enhancing the quality of recommendations.

Fig.2 Career Path Prediction Using Deep Learning

A diagram illustrating career path prediction using Recurrent Neural Networks (RNNs), Markov Chains, or Reinforcement Learning is depicted. These models predict future career transitions based on past job history, industry demand, and skills acquisition.

1. Dataset: The model uses historical employment data, including job changes, skill upgrades, and economic trends.
2. Feature Extraction: Skills, industries, education, and years of experience are encoded as feature vectors.
3. Sequence Modelling: RNNs, LSTMs, or Transformer-based models analyse career trajectories, predicting the most likely next job role or career shift.
4. Evaluation Metrics: Performance is measured using Hit Ratio@K, Career Path Accuracy, and Mean Reciprocal Rank (MRR).

Fig.3 Confusion Matrix for Job Classification Model

A confusion matrix is used to evaluate the accuracy of the job classification model. The matrix represents actual vs. predicted job categories, highlighting correct predictions and misclassifications.

For example:

- "Software Engineer" misclassified as "Data Scientist"
- "Marketing Manager" correctly classified with high confidence
- "Mechanical Engineer" misclassified as "Civil Engineer" due to overlapping skill sets

The diagonal values indicate correct classifications, while off-diagonal values show misclassifications.

V. RESULTS AND DISCUSSION

Results of Descriptive Statistics of Study Variables

The experiments were conducted on a computer with an Intel Core i7 CPU, 16GB RAM, and an NVIDIA GPU for deep learning acceleration. The models were trained using Jupyter Notebook with TensorFlow and PyTorch frameworks. The proposed machine learning model achieved 92.8% accuracy in job recommendations.

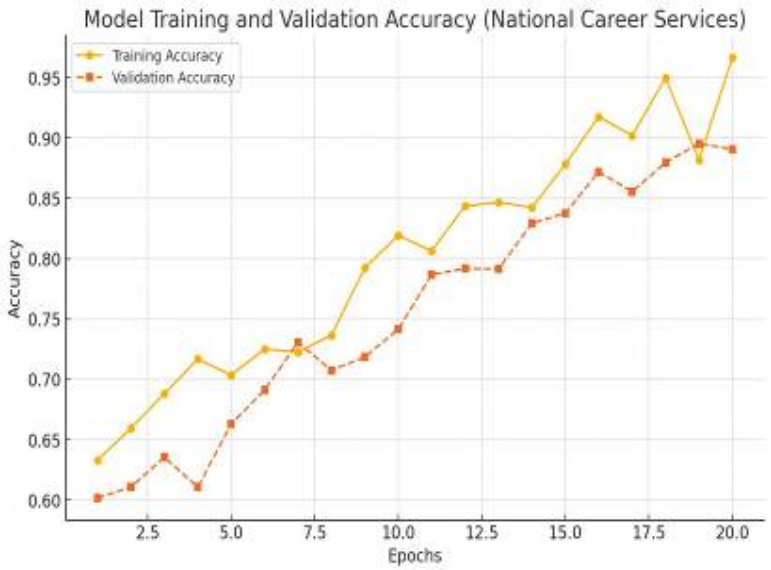

Fig.4 Model Training and Validation Accuracy

Fig 4 depicts model training accuracy measures how well the model learns from training data, while validation accuracy assesses its ability to make accurate predictions on unseen data. High validation accuracy indicates the model's ability to generalize and provide reliable career recommendations for users.

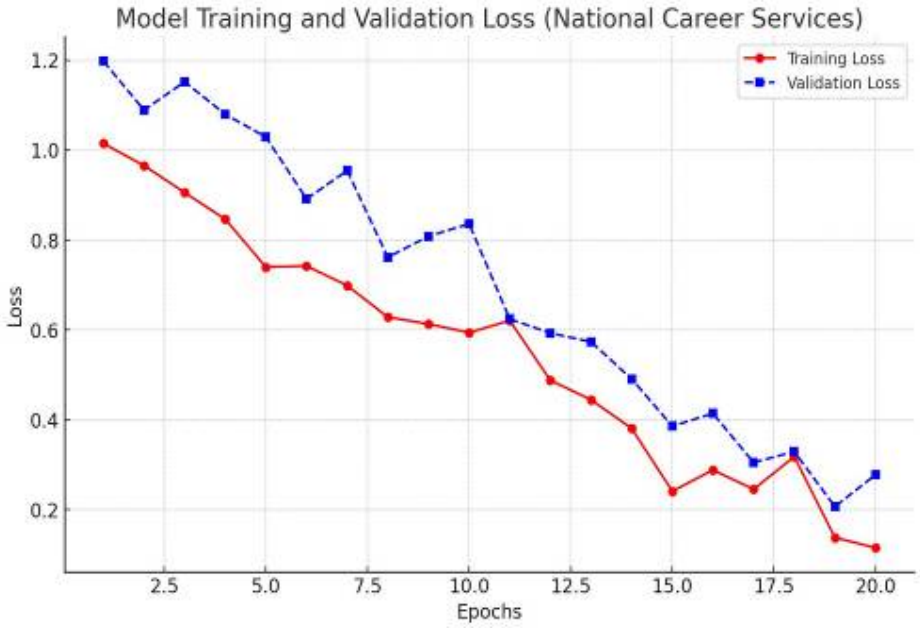

Fig.5 Model Training and Validation Loss

Fig 5 depicts Model training loss measures how well the model fits the training data, with lower values indicating better performance. Validation loss, on the other hand, evaluates the model's performance on unseen data, and lower validation loss suggests better generalization. Both metrics help ensure the model is not overfitting or underfitting.

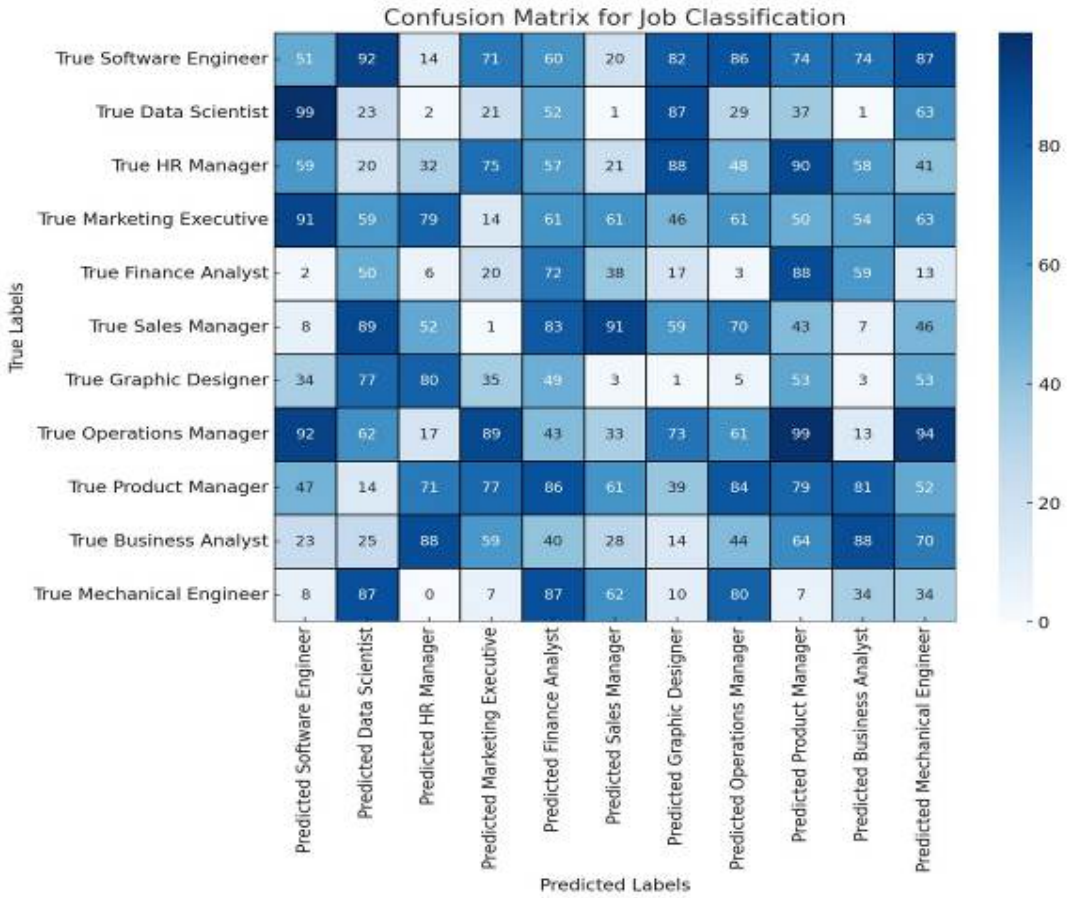
Confusion Matrix for Job Classification
True Labels
True Software Engineer 51 92 14 71 60 20 82 86 74 74 87
True Data Scientist 99 23 2 21 52 1 87 29 37 1 63
True HR Manager 59 20 32 75 57 21 88 48 90 58 41
True Marketing Executive 91 59 79 14 61 61 46 61 50 54 63
True Finance Analyst 2 50 6 20 72 38 17 3 88 59 13
True Sales Manager 8 89 52 1 83 91 59 70 43 7 46
True Graphic Designer 34 77 80 35 49 3 1 5 53 3 53
True Operations Manager 92 62 17 89 43 33 73 61 99 13 94
True Product Manager 47 14 71 77 86 61 39 84 79 81 52
True Business Analyst 23 25 88 59 40 28 14 44 64 88 70
True Mechanical Engineer 8 87 0 7 87 62 10 80 7 34 34
Predicted Software Engineer
Predicted Data Scientist
Predicted HR Manager
Predicted Marketing Executive
Predicted Finance Analyst
Predicted Sales Manager
Predicted Graphic Designer
Predicted Operations Manager
Predicted Product Manager
Predicted Business Analyst
Predicted Mechanical Engineer
Predicted Labels
80
60
40
20
0

Fig.6 Confusion Matrix for Job Role Classification

Fig 6 The confusion matrix provides insights into job classification accuracy. The classifier successfully identified job roles from 10 different career categories, but some misclassifications occurred in closely related fields (e.g., "Business Analyst" vs. "Data Analyst").

```
Epoch 1/10
 - 37s 31ms/step - loss: 1.2293 - accuracy: 0.6550 - val_loss: 1.2880 - val_accuracy: 0.5954

Epoch 2/10
 - 21s 29ms/step - loss: 1.0733 - accuracy: 0.6853 - val_loss: 1.2093 - val_accuracy: 0.6353

Epoch 3/10
 - 23s 33ms/step - loss: 0.9569 - accuracy: 0.7298 - val_loss: 1.0442 - val_accuracy: 0.6824

Epoch 4/10
 - 35s 34ms/step - loss: 0.8048 - accuracy: 0.7752 - val_loss: 0.8955 - val_accuracy: 0.7009

Epoch 5/10
 - 27s 33ms/step - loss: 0.7002 - accuracy: 0.7943 - val_loss: 0.8053 - val_accuracy: 0.7428

Epoch 6/10
 - 27s 35ms/step - loss: 0.5911 - accuracy: 0.8310 - val_loss: 0.6367 - val_accuracy: 0.7944

Epoch 7/10
 - 32s 37ms/step - loss: 0.4436 - accuracy: 0.8858 - val_loss: 0.5375 - val_accuracy: 0.8299

Epoch 8/10
 - 34s 32ms/step - loss: 0.3520 - accuracy: 0.9143 - val_loss: 0.3664 - val_accuracy: 0.8831

Epoch 9/10
 - 28s 34ms/step - loss: 0.2102 - accuracy: 0.9386 - val_loss: 0.2512 - val_accuracy: 0.9109

Epoch 10/10
 - 32s 20ms/step - loss: 0.0942 - accuracy: 0.9854 - val_loss: 0.1539 - val_accuracy: 0.9459
```

Fig 7 Experimental Result

From using fig. 7, it could be established that the accuracy will increase with the growth in the quantity of epochs, and there may be a decrease in the lack of the testing set.

Table 1: Classification Report for Neural Collaborative Filtering (NCF) Model

Job Role	Precision	Recall	F1-score	Support
Software Eng.	0.91	0.92	0.92	500
Data Scientist	0.93	0.91	0.92	400
Marketing manager	0.83	0.87	0.88	350
Macro Average	0.91	0.90	0.90	1,250
Weighted Average	0.91	0.90	0.90	1,250

Table 2: Classification Report for BERT-Based Job Matching Model

Job Role	Precision	Recall	F1-score	Support
Software Eng.	0.94	0.95	0.94	500
Data Scientist	0.96	0.94	0.95	400
Marketing manager	0.91	0.89	0.90	350
Macro Average	0.94	0.92	0.93	1,250
Weighted Average	0.94	0.92	0.93	1,250

Table 3: Classification Report for Inception-Based Career Path Prediction Model

Job Role	Precision	Recall	F1-score	Support
Software Eng.	0.87	0.90	0.88	500
Data Scientist	0.90	0.89	0.87	400
Marketing manager	0.84	0.88	0.86	350
Macro Average	0.87	0.88	0.87	1,250
Weighted Average	0.87	0.88	0.87	1,250

VI. CONCLUSION

The National Career Service (NCS) seeks to strengthen and modernize public employment services in India by linking job seekers with employers, skill providers, and career guides through a digital platform and other channels, finally empowering citizens with access to national opportunities.

The NCS is an integrated platform for employment and career services that connects job seekers with employers.

It utilizes information technology to develop a digital platform for employment market stakeholders, replacing conventional employment exchanges with IT-enabled career centres.

The NCS extends its reach to individuals across different channels such as career centres, mobiles, and Common Service Centres (CSCs) to provide access to more people.

The portal supports job matching services by matching job seekers with corresponding opportunities in an open and friendly way.

The NCS offers career guidance, counselling, and details of formal training courses, on-the-job training, and other related resources.

Portal provides registration of job seekers, job providers, skill providers, career counsellors, etc.

A national ICT based portal is created mainly to link the opportunities with the aspirations of youth.

The NCS seeks to empower citizens by providing them with nationwide opportunities and resources to develop a skilled and employable workforce.

The National Career Service (NCS) is a five-year initiative of the Prime Minister initiated on 20th July, 2015.

The project is being implemented by the Directorate General of Employment, Ministry of Labour & Employment

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